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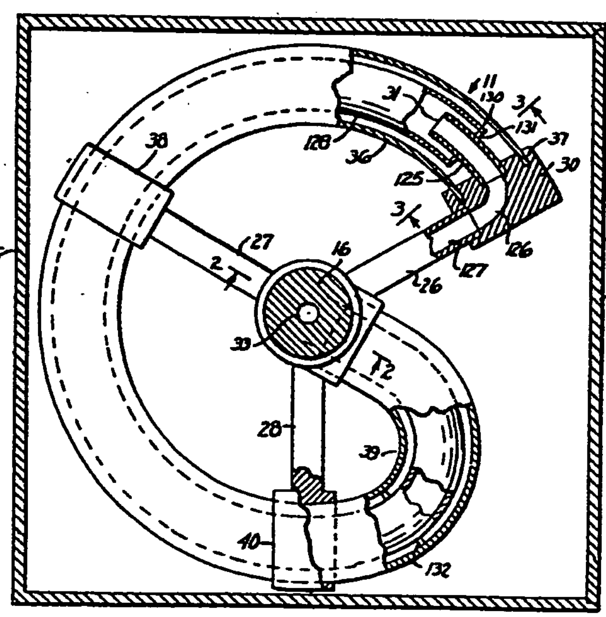
(57) Abstract

A motor having a rotary unit (11) rotatably mounted within an air evacuated housing (12). The rotary unit (11), having a balanced inertial mass (30, 38, 40), is driven in a continuous manner by a reaction drive unit (125, 126, 127, 128) which derives its power from the exterior of the housing (12). Since the rotary unit (11) operates within a near vacuum environment and comprises an inertial mass (30, 38, 40) driven by a reactive force, a high degree of energy transmission efficiency is effected.



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ROTARY MOTOR AND METHOD OF OPERATING SAME

TECHNICAL FIELD

This invention relates to rotary motors and has particular reference to a motor having a rotor to which power means, such as fluid under pressure, is applied to transmit rotation to a load.

BACKGROUND ART

In an earlier filed United States patent application, Serial Number 802,503, filed June 1, 1977, by the present applicant herein, Karl M. Aegerter, a fluid driven reciprocating piston type motor is disclosed and claimed in which air above atmospheric pressure is applied to one side of each piston while a suction below atmospheric pressure is applied to the opposite side of the piston. At the end of each stroke, the application of air pressure and suction is reversed to drive each piston in the opposite direction. Such construction results in a greatly improved efficiency of power transmission. The reason for such improved efficiency is believed due, in part, to the fact that air, as well as most fluids, when being moved or encountered at high speeds, acts as a heavy viscous and elastic fluid, thereby adding considerable resistance to such movement. Therefore, since parts of the motor of the aforementioned application operate in a rarified atmosphere, the drag normally incurred by virtue of air being moved about by the pistons and other parts of the motor is substantially eliminated. Also, of course, the near vacuum condition on one side of each piston increases the differential pressure effective to drive the pistons through their strokes. However, such motor requires reciprocating motor elements and a relatively complicated valve system for controlling the motor in order to provide rotary power output. Further, because of the variable speed of each piston as it changes from a zero velocity at each

end of its stroke to a maximum velocity at a mid point in the stroke, vibrations tend to occur and the power output, instead of providing a continuous torque, tends to be uneven.

In addition, the following United States patents are listed below to show various prior art devices that include a chamber and a rotating member associated therewith. Some of said chambers may be air evacuated. It is felt that the following patents will be useful to gain an understanding of the present invention:

8,414	September 18, 1834
1,080,136	December 2, 1913
2,488,191	November 15, 1949
2,637,166	May 5, 1953
3,804,549	April 6, 1974

ADVANTAGEOUS EFFECTS OF THE INVENTION

It therefore becomes a principal object of the present invention to provide a rotary motor having an increased power transmission efficiency.

Another object is to provide a high speed rotary motor of the above type in which the rotor unit operates in a near vacuum condition.

Another object is to provide a rotary motor of the above type which is simple and inexpensive to manufacture.

Another object is to provide a rotary motor of the above type in which, in one embodiment, the rotor is driven by a fluid reaction jet.

Another object is to provide a rotary motor of the above type wherein the rotor is driven by a fluid reaction jet in an air evacuated housing and wherein the jet encounters a minimum amount of resistance.

Another object is to provide a rotary motor of the above type in which, in another embodiment, the rotor is driven by one or more electric motors in an air evacuated housing.

A further object is to provide a rotary motor of the above type in which, in a further embodiment, the rotor is driven by turbine action in an air evacuated housing.

I have discovered that, when a rotating inertial mass is accelerated within an air evacuated chamber, an unusually large amount of energy is derived from a certain amount of input energy, over that derived from such a mass when accelerated in the presence of air or other fluid. This appears to be due, in part, to the fact that the rotating mass is unhindered by any drag which would otherwise be imposed upon it by surrounding air or other fluid mass. However, additional energy is also found to be obtained during acceleration of the rotary mass and this can be applied to a load driven by the rotor. Further, kinetic energy can be transmitted to the load upon deceleration of the rotary mass.

BRIEF DESCRIPTION OF THE DRAWINGS

The manner in which the above and other objects of the invention are accomplished will be readily understood on reference to the following specification when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a sectional view through a rotary motor embodying one form of the present invention, in which the rotor is driven by fluid jet reaction.

FIG. 2 is a transverse sectional view, with parts broken away, of the motor and is taken substantially along the lines 2-2 of FIG. 1.

FIG. 3 is a sectional view through the rotor and is taken along the lines 3-3 of FIG. 1.

FIG. 4 is a sectional view through an alternate embodiment of the invention in which the rotor is driven by electric motors carried thereby.

FIG. 5 is a transverse sectional view through the motor of FIG. 4 and is taken along the lines 5-5 of FIG. 4.

FIG. 6 is a sectional view through a second alternate embodiment of the invention in which the rotor is driven by turbine action.

FIG. 7 is a transverse sectional view taken along the lines 7-7 of FIG. 6.

FIG. 8 is a face view of one of the bucket elements.

FIG. 9 is a sectional view through a third alternate embodiment of the invention, such embodiment being somewhat similar to that shown in FIG. 1 but being effective to reduce resistance to the reaction jet, and is taken along the lines 9-9 of FIG. 10.

FIG. 10 is a transverse sectional view taken substantially along the lines 10-10 of FIG. 9.

FIG. 11 is an enlarged sectional view through the rotor and is taken along the lines 11-11 of FIG. 9.

FIG. 12 is a sectional view, similar to FIG. 10, but with parts broken away and showing a modified embodiment of the motor shown in FIG. 10.

FIG. 13 is a fragmentary sectional view showing the modified embodiment of FIG. 12, the view being somewhat similar to that seen in the upper right hand corner of FIG. 9.

FIG. 14 is a sectional view through an alternate embodiment of the invention.

FIG. 15 is a transverse sectional view taken along the lines 15-15 of FIG. 14.

FIG. 16 is a fragmentary sectional view through a modified embodiment of that shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

While my invention is susceptible to embodiment in many different forms, there are shown in the drawings and will be described in detail only certain embodiments, with the understanding that the particular disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated.

Referring to FIGs. 1 to 3 in particular, a rotor, generally indicated at 11, is provided which is contained within a housing 12 formed by side walls 13 and 14 and end walls 15 integrally united to the side walls to form a hermetically sealed enclosure as well as support for the rotor.

The rotor 11 comprises a central shaft 16 rotatably mounted in ball bearings 17 and 18 supported by hollow hubs 20 formed on the inner facing sides of the housing walls 14 and 15. O-ring seals 21 and 22, preferably of polytetrafluoroethylene material, surround the shaft 16 in wiping engagement therewith and are held against the outer sides of the walls 13 and 14 by retainer plates 23 secured to the side walls by screws 24 to seal against leakage of air into the housing along the outer surface of the shaft 16. The shaft 16 is adapted to be suitably coupled to a load (not shown).

Air is evacuated from the interior of the housing 12 through a tube 25 which may be connected to the suction side of a suitable vacuum pump, not shown, which may be driven by the shaft 16 or by a suitable outside motor source, not shown.

Equiangularly spaced radially extending spoke elements 26, 27 and 28 are suitably secured in sockets, one of which is shown at 29, formed in the shaft 16. Spoke element 26 is tubular and supports an inertial member 30. A jet orifice, indicated at 31, is formed by a tube 125 integral with member 30 and communicating with passages 126 in the member 30 and 127 in the spoke element 26. The orifice tube 125 extends substantially tangentially of the curved path through which it moves about the axis of shaft 16. The inner end of the passage 127 communicates with a passage 33 formed axially in the shaft 16 and extending to the exterior of the housing 12 where it terminates in a rotary fluid coupling 34 of known construction, the latter being connected by a tube 35 to a suitable source of air or other gas preferably under pressure considerably above atmospheric pressure.

A conduit 36 having an internal diameter approximately three times the diameter of the orifice tube 125 is hermetically fitted and secured at 37 to the inertial member 30 and extends in a circular arc, for the most part concentrically about the shaft 16. The conduit 36 passes through and is supported by inertial elements 38 and 40 suitable secured to the outer ends of respective ones of spoke elements 27

and 28. The opposite end of the conduit 36 is curved radially inward at 39 and is secured within an opening 41 in the shaft 16 where it communicates with a second axially extending passage 42 formed in the shaft and leading to the exterior of the housing 12 on the end opposite the passage 33.

A curved tube 128 having a diameter approximately one half the diameter of the conduit 36 is located within conduit 36 and is supported in centered relation to the conduit 36, at one end 130 by equiangularly located spacers 131 (see also FIG. 3) with the end 130 located approximately midway along the length of the orifice tube 125. The tube 128 is held in centered relation to the conduit 36 throughout its length by suitable additional spacers, i.e. 132, extending between the tube 128 and the conduit 36 and is integrally connected at its opposite end to a tube 133 which extends coaxially of shaft 16 and terminates at 134 at an appreciable distance from the adjacent end of its shaft 16.

In operation, as air or other gas is applied under pressure above atmospheric pressure through the supply tube 35, passage 33 and through the orifice tube 125, the resulting jet reaction at the exit side of the orifice 31 provides a thrust to rotate the rotor 11 in a clockwise direction. The exhaust air passing into the exit side of the orifice 31 travels at reduced pressure along the length of the conduit 128 and exits through the terminus 134 in the tube 133 to the atmosphere.

As the gaseous jet stream emerges from the orifice 31 into the tube 128 it tends to create a vacuum in the region 135 intermediate the orifice tube 125 and the interior of the adjacent end of the tube 128, thereby drawing air from the atmosphere, through the annular opening 136 surrounding the tube 133 and thence along the length of the tube 128 and finally into the region 135 to vent such region to the atmosphere and thus neutralize any vacuum tending to occur in that area.

Accordingly, as the rotor is driven clockwise, kinetic energy is imparted to the three inertial elements 30, 38 and 40 and is applied as power to the shaft 16. At high speeds, the air exhausted into the tube 128 due to the clockwise rotation of the rotor 11, tends to be drawn along the tube 128 and then through the axial tube 133 to the exterior of the housing where it is exhausted into the atmosphere. If desired, however, an air evacuating pump, not shown, may be connected to the tube 133 to aid in exhausting such air.

Since air is evacuated from the interior of the housing 12, there will be no air drag against which the rotor 11 must operate. Therefore, in the absence of an adequate load driven by the shaft 16, a suitable speed governor (not shown) of conventional construction would have to be operatively connected to the shaft to prevent the rotor 11 from developing an excessive speed.

In the event, however, the load driven by the shaft 16 overcomes the torque developed by the rotor 11, a booster motor shown partly by dot-dash lines 44 may be entrained through gears 45 and 46 to the shaft to aid in driving the same when such excessive loads are encountered. Motor 44 may alternatively be used under any other conditions to drive the rotor within the evacuated housing 12.

In lieu of air under pressure being applied to the tube 35, to develop a pressure differential at the orifice 31, such could be affected solely be applying a vacuum at the end 134 of tube 133. Also, in lieu of a constant air pressure applied to the tube 35, the air could be applied in bursts or pulses.

Alternatively, the motor may be operated as an internal combustion motor by feeding an explosive fluid fuel through the passage 127 to the orifice 31 where it may be combined with oxygen derived through the outer conduit 36 and suitable ignited. However, in the event a fuel, such as Hydrazine containing an oxygen component, is used, the space between the tube 125 and conduit 128, adjacent the spacers 131, may be suitable sealed off. In such case, the conduit 36 could be omitted.

DESCRIPTION OF THE FIRST ALTERNATE EMBODIMENT

Referring to FIGs. 4 and 5, a rotor unit generally indicated at 47 is enclosed within a hermetically sealed cylindrical housing 48 having a circular outer wall 50 integrally secured to side walls 51 and 52, the housing being supported from a suitable supporting surface by brackets. The rotor unit 47 comprises a shaft 52 rotatably supported by ball bearings 53 and 54 carried by the housing side walls.

An air evacuating tube 55 is attached to the housing 48 for evacuating the same and O-ring seals 56 are mounted on the shaft externally of the bearings 53 and 54 to hermetically seal the shaft against leakage of air into the housing.

A hub 57 is keyed on the shaft 52 and has three equiangularly spaced radially extending sockets 58 to slideably receive plungers 60 formed on three similar carriers 61. Each carrier has an electric motor 62 secured thereto by screws 63. The drive shaft 64 of each motor carries a gear 65 which meshes with a pair of gears 66 and 67 carrying drive rollers 68. The gears and rollers 68 are rotatably mounted on bearing studs 70 attached to the carrier 61. Each carrier 61 is yieldably urged radially outward by a "bellview" type compression spring 71 interposed between the bottom of the socket 58 and the plunger 66 to frictionally engage the rollers 68 with a circular track 72 suitable secured to the inner surface of the housing 48.

Electrical conductors 73 connected in parallel with the circuits of the various motors 62 are passed through an axial passage in the shaft 52 and are electrically connected to respective ones of a pair of slip rings 75 mounted on the shaft 52 and electrically insulated from each other and the shaft by an insulating sleeve 76 interposed between the shaft and the rings. Suitable wiper brushes, not shown, connect a source of electrical power to the rings 75 to drive the motors 62, causing them to rotate the rollers 68 around the track 72 and thus transmit rotation through the carriers 61 to the shaft 52. In this case, the carriers 81 and the electric motors 62, form inertial elements to impart kinetic energy to the rotor unit 47 and the load driven thereby.

DESCRIPTION OF THE SECOND ALTERNATE EMBODIMENT

Referring to FIGs. 6 to 8, a rotor unit generally indicated at 78 is provided within a hermetically sealed cylindrical housing 80 formed by a circular outer wall 81 which is integral with two side walls 82 and 83.

Air is evacuated from the interior of the housing 80 through a tube 84.

The rotor unit 78 comprises a shaft 85 rotatably supported by the housing 80 through ball bearings 86 and 87. O-rings 88 hermetically seal against leakage of air around the shaft 85 and into the housing. A hub member 90 is keyed on the shaft 85 and has three equiangularly spaced radially

extending sockets 91 formed thereon to slideably receive plungers 92 formed on respective ones of three similar turbine bucket members 93. Each of the latter is formed with a cavity 94 opening against the inner surface of the housing wall 81 and surrounded by a rectangular edge 95 over which an accurate sealing member 96 is suitably secured. The member 96 has an opening therethrough registering with the cavity 94 and is formed of a material, such as graphite, having a low coefficient of friction. The member 96 is curved to conform to the arcuate surface of the housing wall 81 and is held in sliding sealing engagement therewith by a "belleview" type spring 97 compressed between the bottom of the socket 41 and the plunger 92.

A jet orifice 98 is formed in the housing wall 81. Orifice 98 opens at its exit side into the interior of housing 80 and opens at its inlet side into an inlet chamber 100 connected to a suitable source of air under pressure, not shown. A poppet valve 101 is mounted in the chamber 100 in cooperative relation with a valve port 102. The valve 101 is slideably mounted in a bearing 99 and is pivoted to a lever 103, fulcrummed at 104 on a pedestal 105, and connected by a link 106 to a cam follower lever 107 which is fulcrummed at 108 on the side wall 82 of the housing. A cam roller 110 on the lever 107 is engageable by a cam fixed on shaft 85, the cam having three equally spaced lobes 86, 87 and 88 to actuate the cam follower lever 107 against the action of a tension spring 110.

An exhaust port 112 is formed in the housing wall 81 in angularly spaced relation to the orifice 98 and is closed by poppet valve 113 slideable endwise in a bearing cage 114 and pivoted to a lever 115 fulcrummed at 116 on a pedestal 119 and connected by link 117 to a cam follower lever 118. The latter is fulcrummed at 120 and carries a cam roller 121 also engageable by the three cam lobes 86, 87 and 88 to intermittently rock the cam follower lever 118 against the action of a tension spring 122.

When the rotor is in its position shown in FIG. 6, the exhaust port 112 is closed and cam lobe 86 is effective to hold poppet valve 101 open, permitting air under pressure to be passed against the wall 123 of the underlying bucket member 93, causing rotation of the rotor 78 in a counterclockwise direction. As the trailing edge 124 of the bucket member 93 approaches the jet orifice 98, the valve 101 closes and the charge of air accumulated in the cavity 94 is carried around to the exhaust port 112. As the leading edge of wall 123 of bucket member 93 passes over the exhaust port 112 the cam lobe 86 causes the valve 113 to open to exhaust trapped air through the port 112 to the atmosphere. As the next succeeding bucket member 93 reaches the orifice 98 the preceding sequence of operation of the valves 101 and 113 is repeated under control of the next succeeding cam lobe 88, thus resulting in continued rotation of the rotor unit 78. Accordingly, the air evacuated condition of the interior of the housing 80 will be maintained as the rotor unit 78 continues its rotation.

In this case, the bucket members 93 form inertial elements to transmit kinetic energy to the shaft 85 and any load driven thereby.

DESCRIPTION OF THE THIRD ALTERNATE EMBODIMENT

Referring to FIGs. 9 to 11, the embodiment shown therein is somewhat similar to that shown in FIGs. 1 to 3, and therefore, for the sake of brevity, those parts which are similar in construction and function to the parts shown in FIGs. 1 to 3 will be identified by similar numerial reference characters and might not be described in detail. It will be noted that the housing 12a is wider than the housing 12 shown in FIGs. 1 and 2, and the shaft 16a is lengthened to reach between the bearings 17a and 18a. Also, the conduit 36a is formed concentrically of the axis of the shaft 16a from the inertial element 30a to the inertial element 40a and is located in a single plane a-a extending normal to the axis of shaft 16a. However, that portion 139 of the conduit 36a which extends to the right (FIG. 9) of the inertial element 40a gradually curves radially inwardly toward the shaft 16a while gradually curving laterally, as seen in FIG. 10, in a sweeping spiral volute curve from the plane a-a until it merges with the shaft 16a. The interior passage 137 of conduit 36a also merges gradually with the axially extending passage 42a of shaft 16a.

A conduit 142 forming an extension of shaft 16a, and communicating with passage 42a, extends exteriorly of the housing 12a and is bent at 143 to form a radially extending section 144 and is further bent at 145 to terminate at 146.

The tube 128a is centered within the conduits 36a and 142 throughout its length by suitable spacers, i.e., 131a and 136a, to terminate in an orifice 147, the axis of which extends at least substantially tangent to the path of movement of such orifice.

It will be noted that the tube 128a presents a continuous gradually curved passage with no sharp corners which might otherwise create a back pressure or resistance to the flow of gases exhausting from the orifice 31a.

Accordingly, when a gas under pressure is applied to the inlet tube 35a and emerges through the orifice 31a and into the tube 128a, it creates a jet reactive force or torque tending to rotate the rotor in a clockwise direction. The gases exhausted through tube 128a are expelled through the orifice 147 to create an additional jet reactive force or torque to rotate the rotor. As the pressure in the region 135a is reduced due to the jet effect of the gas emerging from the orifice 31a, air is drawn through the open end 146 of conduit 142 and is conveyed by conduits 142 and 36a to such region 135a to thus vent the same to the atmosphere and thereby neutralize any vacuum condition which might otherwise tend to occur at that location.

FIGs. 12 and 13 illustrate a modified form of the embodiment shown in FIGs. 9 to 11 and, for the sake of brevity, those parts which are common in structure and function with the parts shown in FIGs. 9 to 11 will be identified by similar numerical reference

characters and those parts which are not illustrated will be understood to be similar to those parts shown in FIGs. 9 to 11, except as noted.

In this case, the tube 128a of FIGs. 9 to 11 is omitted, permitting gas expelled under pressure from the orifice 31b to pass through the conduit 36b and shaft passage 42b, etc. to the atmosphere. The passages 126b in the inertial element 30b and 117b in the spoke element 26b are enlarged to communicate the region 135b adjacent the exit side of the orifice 31b with an enlarged axially extending air passage 138 formed coaxially in the right hand end of shaft 16b to communicate with the atmosphere.

The orifice tube 125b forming the orifice 31b is formed as a continuation of a tube 140 which extends centrally through the passages 126b, 127b, and 138, and through a rotary fluid coupling (not shown), similar to coupling 34 of FIG. 2, to a source of gas under pressure. Spacers, i.e. 141, hold the tube 140 in centered position.

Accordingly, as a gas is applied under pressure through the tube 140 and exits through the orifice 31b into the conduit 36b to form a jet reaction, it draws air from the atmosphere through the passages 138, 127b, and 126b into the region 135b to neutralize any vacuum occuring in such region.

If required in order to intake a sufficient amount of air from the atmosphere, the air intake arrangement shown in FIGs. 9 to 11, and comprising the conduit 36a and tube 128a, may be combined with the air intake arrangement shown in FIGs. 12 and 13 in one structure, thereby enabling air to be drawn into the region 135b from opposite ends of the shaft 16b.

DESCRIPTION OF THE FOURTH ALTERNATE EMBODIMENT

FIGs. 14 and 15 illustrate another modified form of the invention which is somewhat similar to that shown in FIGs. 9 to 11, and therefore, for the sake of brevity, those parts which are similar in construction and function will be identified by similar reference characters and might not be described in detail.

The outer conduit, i.e. 36a of FIG. 9, is omitted and the tube 128b is supported within an evacuated cylindrical chamber 12b by inertial elements 30b, 38b and 40b carried by spoke elements 26b, 27b and 28b, respectively, carried by shaft 16b.

The spoke element 28b is provided with a passage 127b therethrough which is directly connected at one end with the interior of tube 128b through a curved passage 129 in the element 30b and is connected at its opposite end to an axial air conveying passage 33b formed in the shaft 16b. The latter passage communicates through a rotary fluid coupling 34b with an air supply tube 35b.

The tube 128b extends concentrically with the shaft 16b through substantially 315° and the opposite end thereof curves both radially inward and lengthwise of shaft 16b and communicates through an axial passage 150 with a radially extending tube 151 located exteriorly of the housing and suitably secured to the outer end of shaft 16b. The tube 151 is bent at 152 to form an orifice 153 at the outer end thereof, the axis of which extends at least substantially tangent to the path of movement of such orifice as it swings about the axis of shaft 16b.

Accordingly, when air or any other gas is applied under pressure to the inlet tube 35b, it passes through the tube 128b and thence through tube 151 to emerge at the orifice 153. Here, the air creates a jet reaction force to rotate the rotor 11b in a clockwise direction as viewed in FIG. 14. However, by locating the orifice in a position directed in the opposite direction, the rotor 11b would rotate in a counterclockwise direction.

It will be noted that the tube 151 is aligned with the spoke element 26b when viewed along the length of shaft 16b, and as depicted in FIG. 14, since it was found in actual tests that this relationship produces a greater amount of torque.

I have discovered that the greatest amount of output power is developed during acceleration of the rotor 11b. However, since there is obviously an upper limit of speed to which the rotor can be accelerated, a speed governing device is preferably provided. For this purpose, the air supply tube 35b is connected through a controllable valve 155, line 156, and a manually controlled valve 157 to a supply line 158 of air under pressure.

A flyweight governor, generally indicated at 160, is provided to sense upper and lower predetermined limits of speed of the rotor 11b and to control the valve 155 accordingly. The governor comprises a shaft 161 suitably driven by the rotor shaft 16b. Flyweights 162 are pivoted at 163 to brackets 164 integral with the shaft 161 and each has an arm 165 which engages in a circumferential groove 166 formed in a sleeve 167 which is slideably splined on the shaft 161 for endwise movement. A second groove 168 in the sleeve 167 embraces one end of a lever 170 fulcrummed at 171 and connected by linkage 172 to the valve 155. A detent 173 is urged by spring 174 into detenting engagement with either of two spaced notches 175 formed in the lever 170.

A compression spring 176 yieldably presses endwise against the sleeve 167 and is effective, when the rotor 11b is at rest or is rotating below a predetermined lower limit of speed, to overcome the detent 173 and to thus shift sleeve 167 downwardly to rock the lever 170 counterclockwise to its illustrated position in order to cause linkage 172 to open valve 155. Thus,

air under pressure is applied through the rotor 11b and orifice 153 to drive the rotor and any load coupled thereto in a constantly accelerating manner. As the rotor reaches a predetermined higher limit of speed, the flywheights 162 act against the action of spring 176 and detent 173 to rock the lever 170 clockwise to actuate the linkage 172 and thus close the valve 155, permitting the rotor 11b to decelerate while transferring kinetic energy to the load until the lower limit of speed is again reached whereupon the spring 176 again becomes effective to overcome the detent 173 and flyweights to rock the lever 170 counterclockwise to again open the valve 155.

An air pump 177, preferably driven by the rotor shaft 16b, has its outlet connected through an accumulator 178 to the inlet line 156 of valve 155. Thus, after the rotor 11b has been operating for a length of time sufficient to build up pressure within the accumulator 178, the valve 157 may be closed, at least partly, so that a supply of air may be obtained from the pump 177 to drive the rotor.

Alternatively, the axial passage 33b and 150 in shaft 16b may be connected together by a passage indicated by dot-dash lines 180 to thereby transmit air directly along the length of shaft 16b to the tube 151 and orifice 153. In this case, the tube 128b merely contributes additional inertial mass to the rotor 11b. Also a curved tube partly shown by dot-dash lines 181, similar to tube 36a of FIG. 9, may be provided to surround and support the tube 128b, being supported, in turn, by the inertial elements 30b, 38b and 40b to also increase the mass of the rotor.

DESCRIPTION OF THE FIFTH ALTERNATE EMBODIMENT

FIG. 16 illustrates a modification of the embodiment shown in FIGs. 1 to 3, and those parts which are in common with those shown in FIGs. 1 to 3 will be identified by similar numerical reference characters. Wherein, the structure is similar except that the orifice tube 125 and tube 123 of FIGs. 1 to 3 are omitted. Accordingly, a jet orifice is formed at 139 in the element 30c. Air or other gas conveyed under pressure through the passage 127c will cause a jet reaction as it emerges from the orifice 139 to drive the rotor clockwise. The exhausted air will be conveyed to the atmosphere through the tube 36c and axial passage 42c in the shaft 16c.

In the aforesaid embodiments disclosed in FIGs. 1 to 3 and 9 to 16 embodying reaction jet type drive devices, it has been found that somewhat greater efficiency may be obtained by locating the motor with its rotor axis extending vertically.

Also it has been found that under certain speed conditions, usually at lower speeds, somewhat better efficiency may be obtained by not evacuating the housing. In such case, however, a cylindrical housing arranged concentrically about the rotor shaft, as shown at 12b in FIGs. 14 and 15, is preferable. At higher speeds efficiency is inwardly increased by evacuating air from the housing. On the other hand, in certain tests, it has been found that at lower speeds appreciable efficiency may even be obtained by removing the housing.

As an indication of the amount of power developed by the motor of the present invention, an operating model constructed somewhat similar to that shown in FIGs. 14 and 15, operating within an air evacuated housing, and having a rotor weight on the order of 180 pounds, was observed to continuously accelerate at the rate of approximately 100 rpm per second per second under pressure from an air supply in which the unit pressure was actually reduced during such acceleration from 200 lbs. per square inch to 150 lbs. per square inch.

From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the true spirit and scope of the novel concept of the invention. It is, of course, intended to cover by the appended claims all such modifications as fall within the scope of the claims.

CLAIMS

1. A motor comprising
a housing,
a rotor,
means supporting said rotor within said housing for rotation about an axis,
means for evacuating air from the interior of said housing, and reaction drive means within said housing and effective to apply a force to said rotor for rotating said rotor.

2. A motor as defined in Claim 1 wherein said reaction drive means comprises
means on said rotor forming a reaction jet orifice,
the axis of said orifice extending at least substantially tangentially of the path of movement of said orifice,
means for applying a fluid under pressure through said orifice whereby to apply a torque to said rotor, and
means for conveying said fluid after passing through said orifice to the exterior of said housing.

3. A motor as defined in Claim 2 wherein said conveying means comprises conduit means,
a portion of said conduit means extending through said supporting means and coaxially of said axis.

4. A motor as defined in Claim 2 wherein said fluid applying means comprises conduit means,
a portion of said conduit means extending through said supporting means and coaxially of said axis.

5. A motor as defined in Claim 1 wherein said reaction drive means comprises means on said rotor forming a first reaction jet orifice, the axis of said orifice extending at least substantially tangentially of the path of movement of said orifice, means for applying a fluid under pressure through said orifice whereby to apply a torque to said rotor, and conduit means rotatable with said rotor for conveying said fluid after passing through said orifice to the exterior of said housing, said conduit means forming a second reaction jet orifice exterior of said housing and offset radially from said axis, the axis of said second orifice extending at least substantially tangentially of the path of movement of said second orifice whereby said fluid passing through said second orifice will apply a torque to said rotor.

6. A motor as defined in Claim 2 wherein said rotor comprises a shaft rotatably supported by said supporting means and extending to the exterior of said housing, said orifice having a fluid entrance side and a fluid exit side, said conveying means comprising fluid conduit means extending from said exit side of said orifice and through said shaft to the exterior of said housing.

7. A motor as defined in Claim 2 wherein said rotor comprises a shaft rotatably supported by said supporting means and extending to the exterior of said housing,

said orifice having a fluid entrance side and a fluid exit side,

said applying means comprising fluid conduit means extending from said entrance side of said orifice and through said shaft to the exterior of said housing.

8. A motor as defined in Claim 1 wherein said rotor comprises a shaft rotatably supported by said supporting means and extending to the exterior of said housing,

said reaction drive means comprising means on said rotor forming a reaction jet orifice,

said orifice having a fluid entrance side and a fluid exit side, the axis of said orifice extending at least substantially tangentially of the path of said orifice,

first conduit means extending through said shaft for applying a fluid under pressure from the exterior of said housing to said entrance side of said orifice whereby to apply a torque to said rotor, and

second conduit means independent of said first conduit means and extending through said shaft for conveying said fluid from said exit side of said orifice to the exterior of said housing.

9. A motor as defined in Claim 8 wherein said second conduit means comprises a second reaction jet orifice located exteriorly of said housing,

the axis of said second orifice extending at least substantially tangentially of the path of said second orifice whereby to apply a torque to said rotor.

10. A motor as defined in Claim 1 wherein said rotor comprises a shaft rotatably supported by said supporting means and extending to the exterior of said housing,

said rotor comprising inertial mass elements spaced around said shaft,

spoke members extending from said shaft and supporting respective ones of said inertial mass elements forming a reaction jet orifice,

the axis of said orifice extending at least substantially tangentially of the path of movement of said orifice,

said orifice having a fluid entrance side and a fluid exit side,

first conduit means extending through said shaft and through the said spoke member supporting said one element to said entrance side of said orifice from the exterior of said housing for applying fluid under pressure to said orifice whereby to apply a torque to said rotor, and

second conduit means independent of said first conduit means and extending from said exit side of said orifice and through said shaft to the exterior of aid housing for conveying said fluid from said orifice to the exterior of said housing.

11. A motor as defined in Claim 1 wherein said reaction drive means comprises

means on said rotor forming a reaction jet orifice having a fluid entrance side and a fluid exit side,

the axis of said orifice extending at least substantially tangentially of the path of said orifice,

means for applying a fluid under a predetermined pressure through said orifice from said entrance side to said exit side whereby to cause said fluid to form a reaction jet to apply a torque to said rotor,

means for conveying said fluid after passing through said orifice to the exterior of said housing, and

means for applying a fluid under a pressure below said predetermined pressure adjacent said reaction jet.

12. A motor as defined in Claim 1 wherein said reaction drive means comprises

means on said rotor forming a reaction jet orifice having a fluid entrance siae and a fluid exit side,

the axis of said orifice extending at least substantially tangentially of the path of said orifice,

means for applying a fluid under pressure through said orifice from said entrance side to said exit side whereby to cause said fluid to create a reaction to apply a torque to said rotor, and

means for venting said exit side to the exterior of said housing.

13. A motor as defined in Claim 2 wherein said rotor comprises a shaft rotatably supported by said supporting means and extending to the exterior of said housing,

said orifice having a fluid entrance side and fluid exit side,

said conveying means comprising fluid conduit means extending from said exit side of said orifice and through said shaft to the exterior of said housing, and

second conduit means surrounding said first mentioned conduit means and extending from said exit side of said orifice and through said shaft to the exterior of said housing for venting said exit side of said orifice to the atmosphere.

14. A motor as defined in Claim 13 wherein said first mentioned conduit means terminates in a second reaction jet orifice located exteriorly of said housing and radially offset from said axis,

the axis of said second orifice extending at least substantially tangentially of the path of said second orifice whereby to cause said fluid passing through said second orifice to apply a torque to said rotor.

15. A motor as defined in Claim 1 wherein said reaction drive means comprises an elongated tubular element carried by said rotor and forming a reaction jet orifice,

the axis of said tubular element extending at least substantially tangentially of the path of said tubular element,

means for applying a fluid under pressure through said tubular element and through said orifice whereby to apply a torque to said rotor,

first fluid conduit means extending over at least a portion of the length of said tubular element for conveying said fluid from said orifice to the exterior of said housing,

there being a space between said first conduit means and said tubular element, and

a second conduit means for venting said space to the exterior of said housing.

16. A motor as defined in Claim 13 wherein said rotor supporting means comprises a shaft and spoke elements carried by said shaft for supporting said rotor,

said second conduit means comprising one of said spoke elements.

17. A motor as defined in Claim 2 comprising a second drive means exterior of said housing for rotating said rotor.

18. A motor as defined in Claim 1 wherein said reaction drive means comprises

drive rollers rotatable supported by said rotor in rolling engagement with said housing, and

drive means carried by said rotor for rotating said rollers whereby to rotate said rotor.

19. A motor as defined in Claim 1 wherein said rotor comprises a member having a cavity therein and a sealing surface surrounding said cavity,

said sealing surface slideably engaging the inner surface of said housing whereby to hermetically seal the interior of said cavity from the interior of said housing,

means on said housing forming a jet orifice,

the axis of said orifice extending into the interior of said housing,

means for applying a fluid under pressure through said orifice whereby to impinge against a side of said cavity to rotate said rotor, and

means on said housing forming an exhaust port opening into said interior of said housing in the path of said member for conveying said fluid from said cavity.

20. A motor as defined in Claim 19 comprising valve means operable in time with rotation of said member for controlling flow of said fluid through said orifice and through said exhaust port.

21. A motor as defined in Claim 20 wherein said housing comprises a cylindrical wall surrounding said member, and

means yieldably urging said member radially outward to maintain said sealing surface of said member in sliding sealing engagement with said cylindrical wall.

22. A motor as defined in Claim 1 wherein said rotor comprises

a plurality of members spaced around said axis,

each of said members having a cavity in the outer periphery thereof,

means yieldably urging each of said members radially outward whereby to slideably hermetically seal the interior of said cavities from the interior of said housing,

means on said housing forming a jet orifice,

the axis of said orifice extending into the interior of said housing,

means for applying a fluid under pressure through said orifice whereby to impinge against the side of said cavity adjacent said orifice whereby to rotate said rotor,

means on said housing forming an exhaust port opening into said interior of said housing whereby to convey said fluid from said cavities, and

valve means operable by said rotor for controlling flow of said fluid through said orifice when each of said cavities is there adjacent and for controlling flow of said fluid through said exhaust port when each of said cavities is there adjacent.

23. A motor comprising

a housing,

a rotary mass for coupling to a load,

means for supporting said mass within said housing for rotation about an axis,

means for evacuating air from the interior of said housing, and

means for rotating said mass from the exterior of said housing.

24. A motor as defined in Claim 23 wherein said rotary mass comprises conduit means,

said conduit means forming a reacting jet orifice at the exterior of said housing,

said orifice being offset radially from said axis,

the axis of said orifice extending at least substantially tangentially of the path of movement of said orifice, and

means for applying fluid under pressure through said conduit means to said orifice.

25. A motor as defined in Claim 24 wherein a portion of said conduit means extends through said housing and coaxially of said axis.

26. A motor as defined in Claim 24 wherein said mass comprises a shaft rotatably supported by said supporting means and extending to the exterior of said housing,

said conduit means extending through said shaft.

27. A motor as defined in Claim 28 wherein said mass comprises a curved conduit extending at least substantially concentrically of said axis,

first tubular fluid conveying means extending into said housing from the exterior of said housing,

means for applying fluid under pressure to said first conveying means,

said conveying means having a portion within said housing and extending radially of said axis for conveying said fluid from said applying means to one end of said conduit, and

second tubular conveying means extending to the exterior of said housing from the interior of said housing,

said second conveying means forming a jet reaction orifice at the exterior of said housing,

said second conveying means having a portion within said housing and extending radially of said axis to convey said fluid from the opposite end of said conduit to said orifice,

said portion of said second conveying means being substantially aligned with said portion of said first conveying means when viewed lengthwise along said axis of said mass.

28. A motor comprising a rotary mass for coupling to a load,

means supporting said mass for rotation about an axis,

said mass comprising conduit means,

said conduit means forming a reaction jet orifice offset radially from said axis,

the axis of said orifice extending at least substantially tangentially of the path of movement of said orifice, and

means for applying fluid under pressure through said conduit means to said orifice whereby to cause rotation of said rotor.

29. A motor as defined in Claim 28 wherein said conduit means extends in an arcuate path concentric with said axis.

30. A motor as defined in Claim 28 wherein said rotation axis extends vertically.

31. A motor comprising

a rotor having an inertial mass,

means supporting said rotor for rotation about an axis, and

means for rotating said rotor at a continually accelerating rate of rotation.

32. A motor as defined in Claim 31 comprising means responsive to said rotor upon reaching a predetermined speed for permitting said rotor to decelerate.

33. A motor as defined in Claim 32 comprising means responsive to said rotor upon reaching said predetermined speed for disabling said rotating means whereby to permit said rotor to decelerate to a second predetermined speed and for thereafter enabling said rotating means.

34. A motor as defined in Claim 33 wherein said motor comprises a housing,

said supporting means supporting said rotor within said housing, and

means for evacuating air from said housing.

35. The method of transmitting power to a load which comprises rotatably supporting an inertial mass within a chamber,

evacuating air from said chamber,

coupling said mass to said load, and

rotating said mass while continually accelerating the rate of rotation of said mass.

36. The method of transmitting power to a load as defined in Claim 35 which comprises allowing said mass to decelerate after said mass reaches a predetermined speed of rotation.

37. The method of transmitting power to a load as defined in Claim 36 which comprises again accelerating the rate of rotation of said mass after said mass reaches a second predetermined speed lower than said first mentioned predetermined speed.

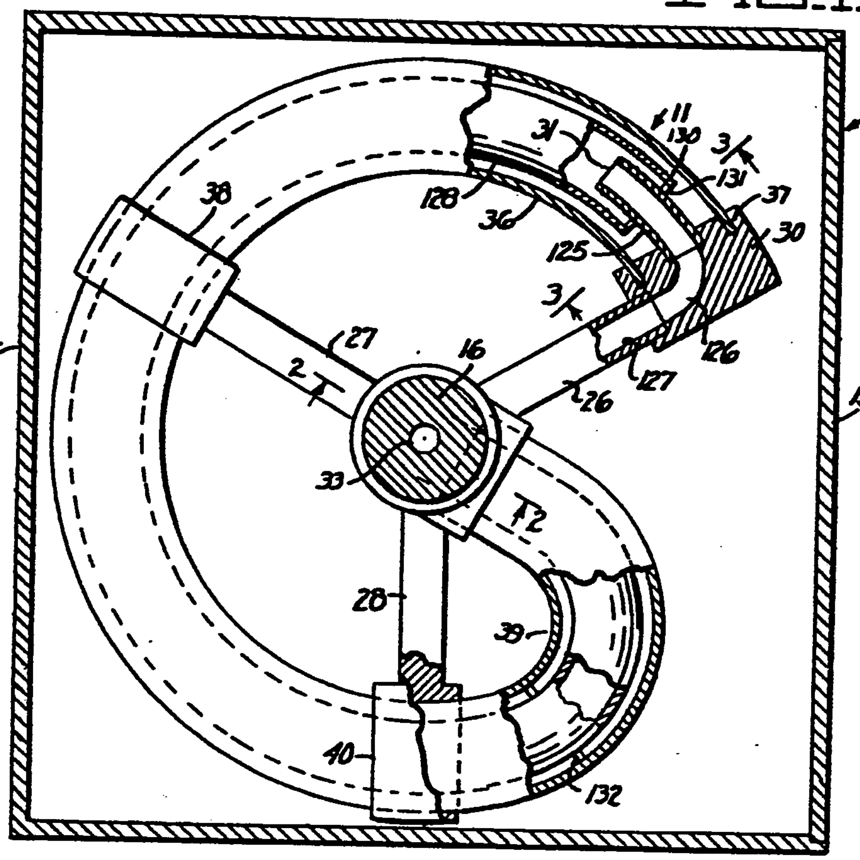

FIG.1.

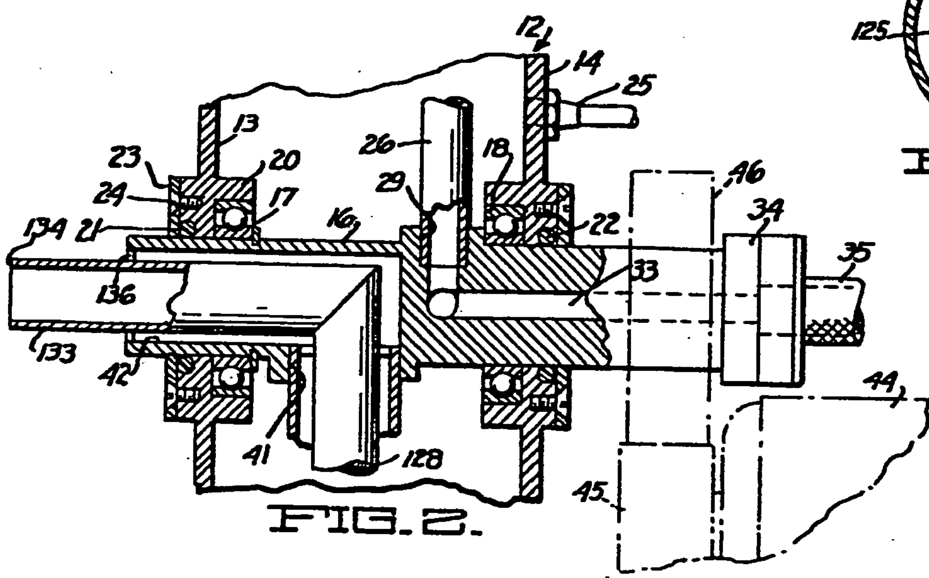

FIG.2.

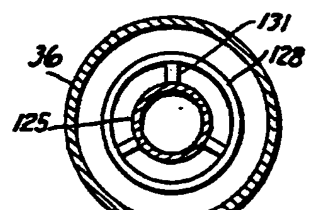

FIG.3.

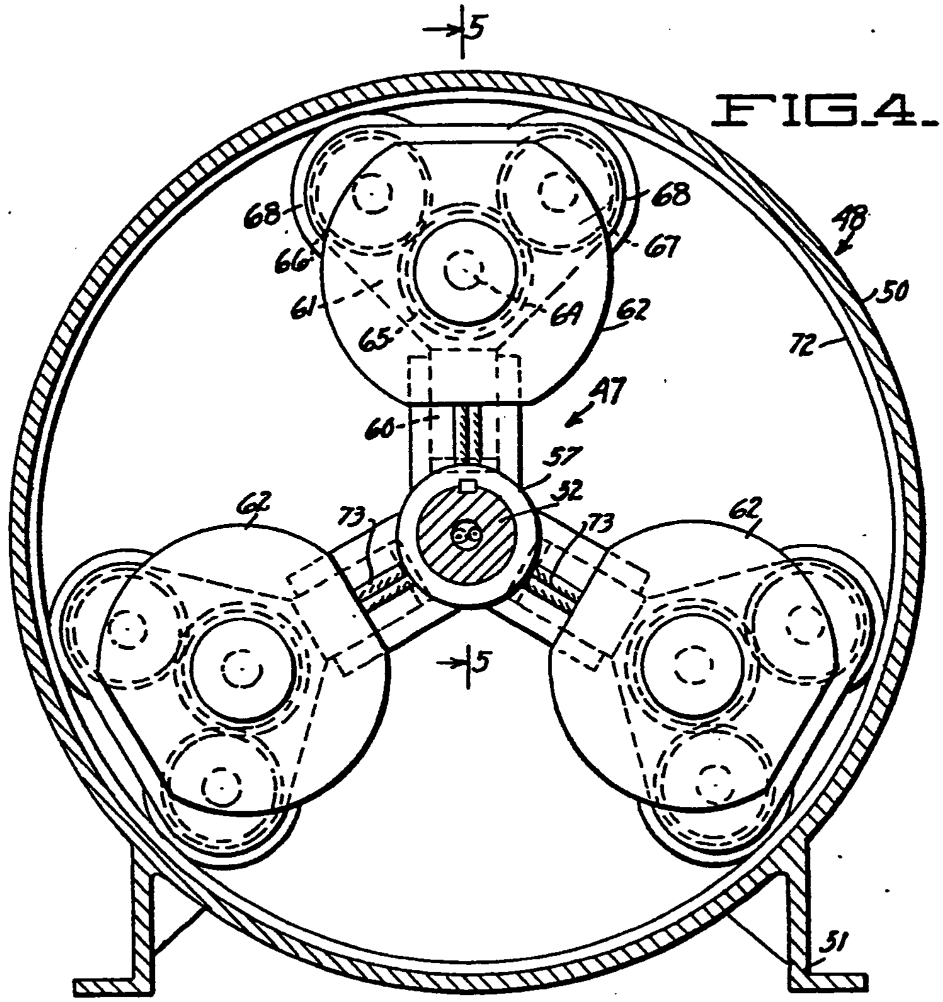
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FIG.4.

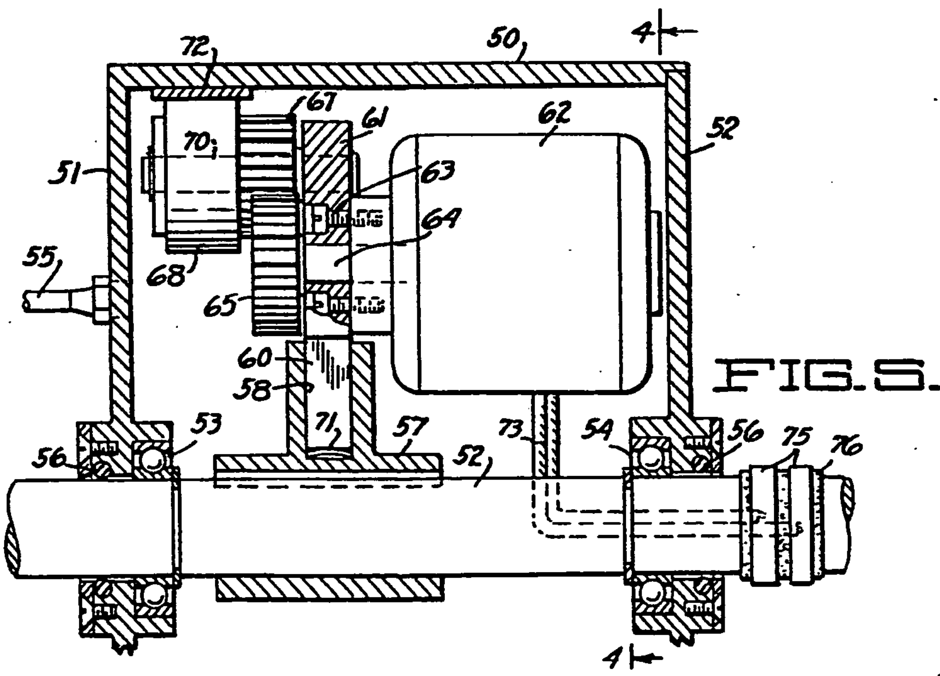
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FIG.5.

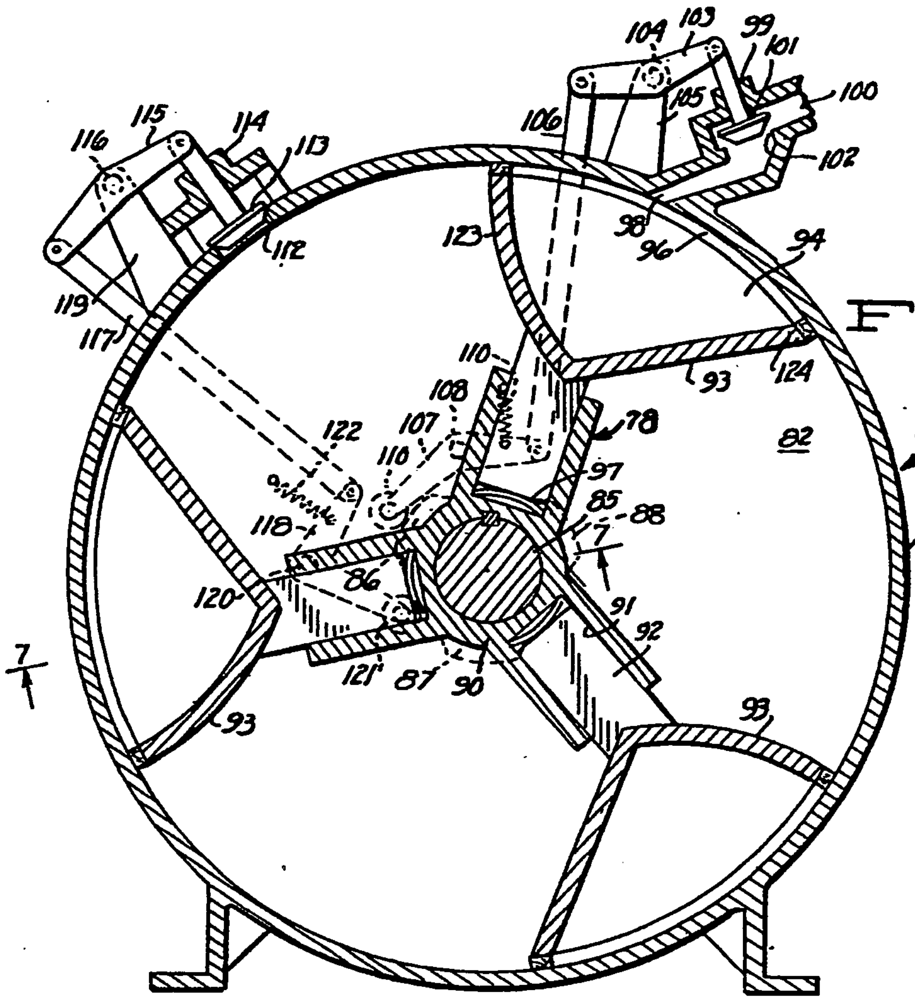
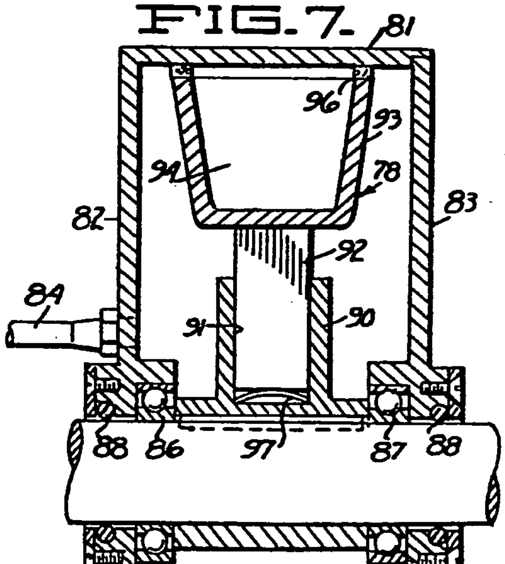


FIG.6.

FIG.7.



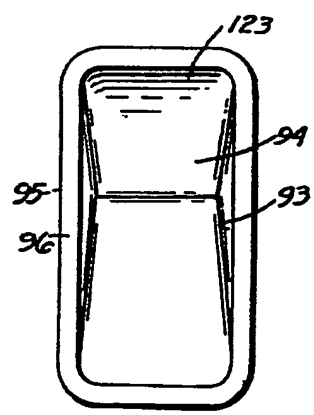


FIG.8.

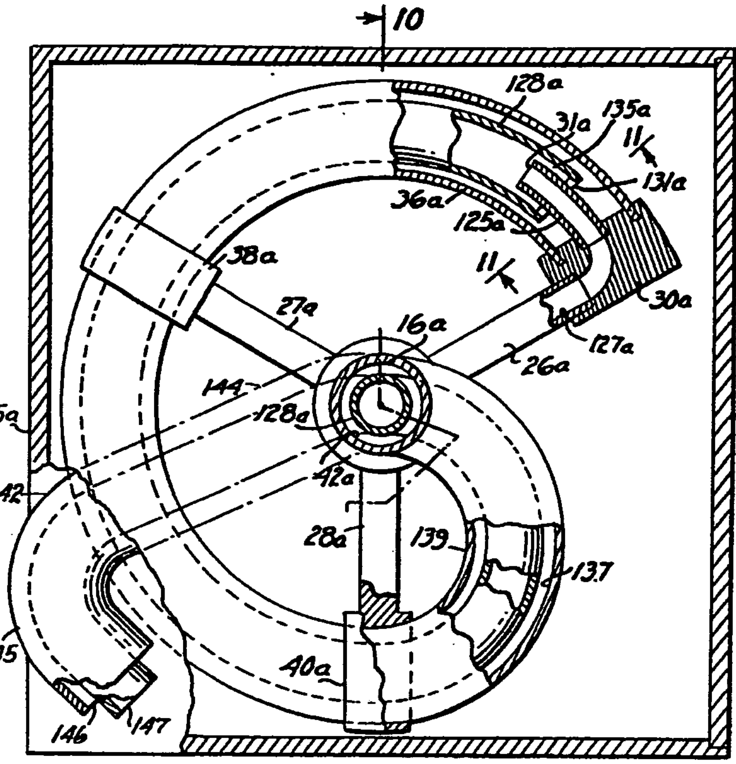


FIG. 9.

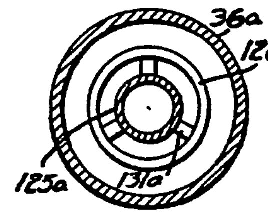
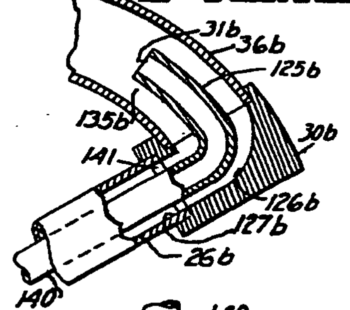


FIG. 11.

FIG. 13.



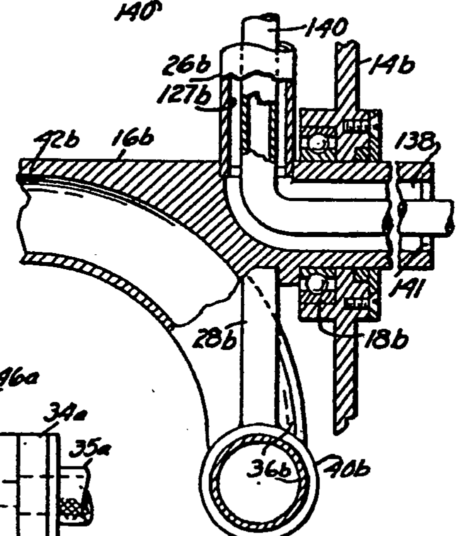


FIG. 12.

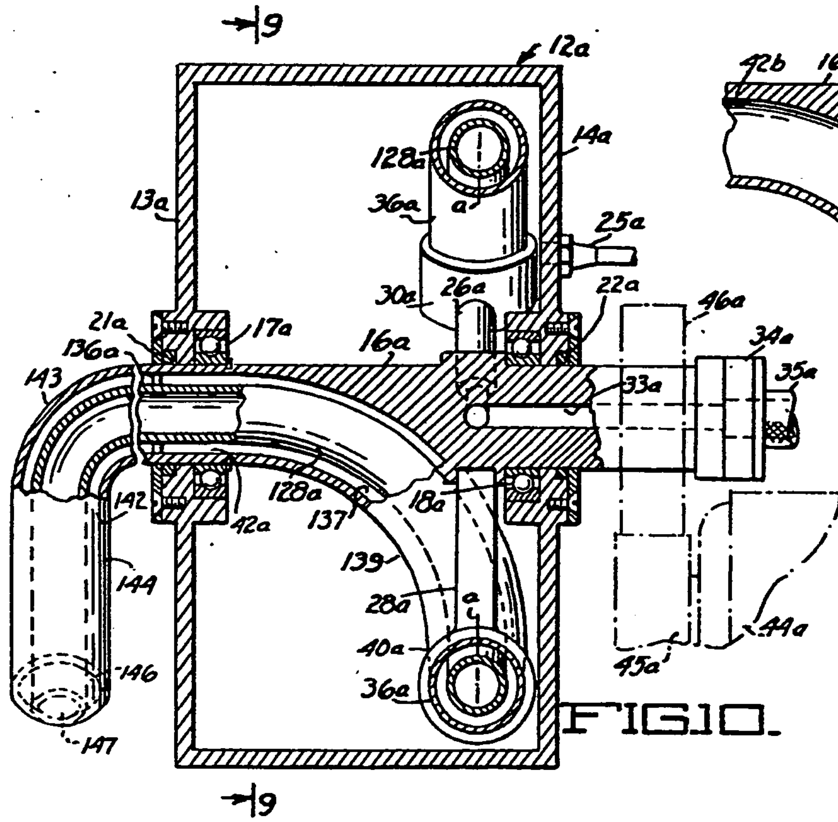


FIG. 10.

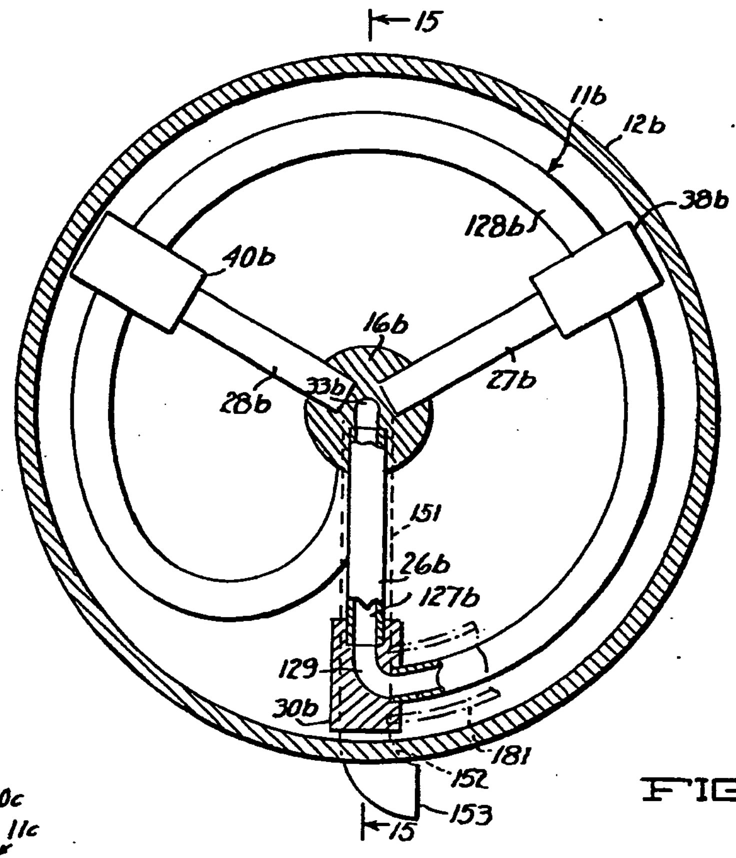


FIG.14.

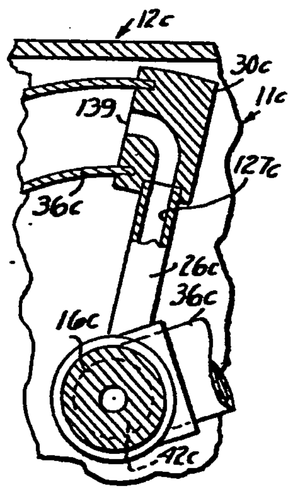


FIG.16.

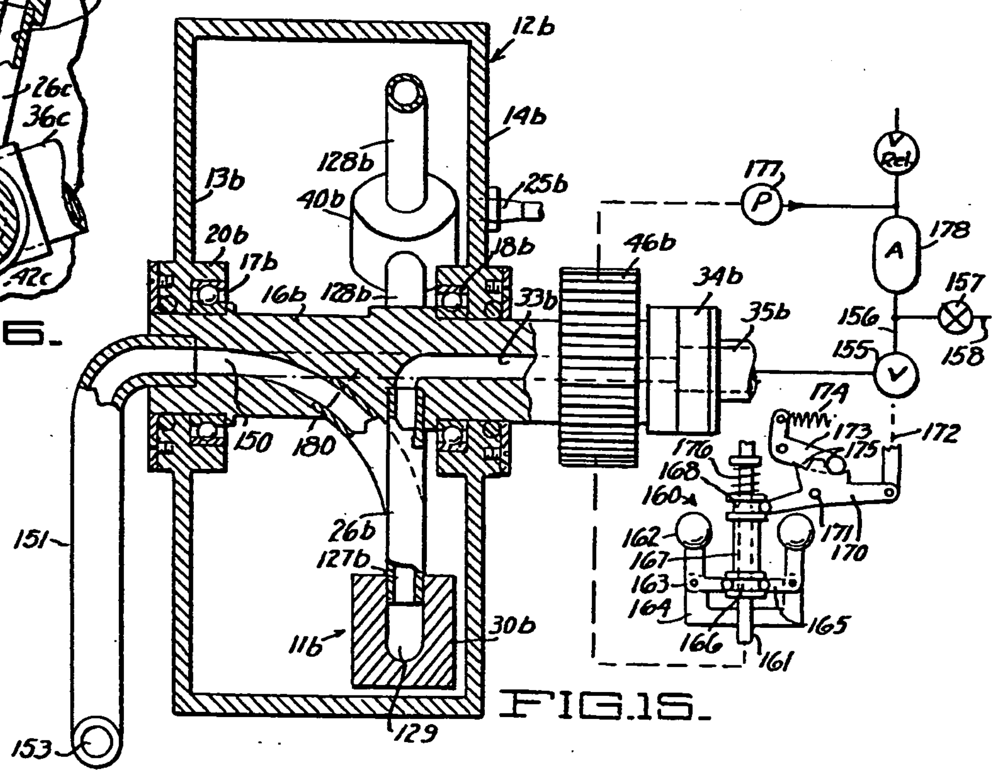


FIG.15.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US79/00241

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl. F 01 B 1/18
U.S. Cl. 415/80

WO79/00969

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	60/39.34, 39.35, 39.44 310/74 415/36, 80, 81, 82, 92 74/572

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	US,A, 4,031,420, Published 21 June 1977 Carini	18
A	US,A, 4,027,484, Published 7 June 1977 Wallis	1-17, 23-30
X	U S,A, 3,804,549, Published 16 April 1974 Kellenbarger	1-17 23-30
X	US,A, 3,767,320, Published 23 October 1973 Theis et al	31-37
A	US,A, 3,485,037, Published 23 December 1969 Clerk	1-17 23-30
X	US,A, 2,994,195, Published 1 August 1961 Carswell	1-17 23-30
X	US,A, 2,861,776, Published 25 November 1958 Magill	1-17 23-30
X	US, A,2,669,836, Published 23 February 1954 Abbott	1-17 23-30

* Special categories of cited documents: [15]

"A" document defining the general state of the art

"E" earlier document but published on or after the international filing date

"L" document cited for special reason other than those referred to in the other categories

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but on or after the priority date claimed

"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention

"X" document of particular relevance

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
8 August 1979	29 AUG 1979
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	L. J. Casaregola

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

X	US,A, 2,637,166, Published 5 May 1953 Carswell	1-17 23-30
X	US,A, 1,533,767, Published 14 April 1925 Schmidt	31-37
X	US,A, 1,131,803, Published 16 March 1915 Stewart	19-22
X	US,A, 751,842 Published 9 February 1904 Ericson	19-22

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [10]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ______, because they relate to subject matter [12] not required to be searched by this Authority, namely:

2. ☐ Claim numbers ______, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [13], specifically:

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [11]

This International Searching Authority found multiple inventions in this international application as follows:

I) Claims 1-17 and 23-30 drawn to a jet reaction turbine (415/80)

II) Claim 18 drawn to a flywheel type power transmission (74/572)

see sheet next page

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

III) Claims 19-22 drawn to a closed pocket turbine (415/92).

IV) Claims 31-37 drawn to a motor speed control (415/36).

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [10]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ______, because they relate to subject matter [12] not required to be searched by this Authority, namely:

2. ☐ Claim numbers ______, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [13], specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [11]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.